APPARATUS AND METHOD FOR REPRESENTING MULTI-LEVEL LOD THREE-DIMENSIONAL IMAGE

RELATED APPLICATION

[0001] The present application is based on, and claims priority from, Korean Application Number 2004-00107657, filed Dec. 17, 2004, and 2005-0061731, filed Jul. 8, 2005 the disclosure of which is hereby incorporated by reference herein in its entirety.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a computer graphic system, and more particularly, to an apparatus and a method for representing a three-dimensional model with a vast amount of data such as a large-scale terrain model in a computer system in real time.

[0004] 2. Description of the Related Art

[0005] Recently, a rapid advancement of computer graphic fields such as a virtual reality system and a computer game has led to a development of various methods to represent numerous objects in the real world and terrain in three dimensions. A mesh model has been mainly employed to represent three-dimensional objects of the real world in a computer system. The mesh model particularly represents three-dimensional surfaces of objects or terrain using a collection of a plurality of triangles, tetragons or polygons which are correlated with each other.

[0006] For a three-dimensional representation of a vast amount of data such as a large-scale of terrain in a computer system in real time using the mesh model, specific techniques of generating, managing and representing proper terrain are required to effectively utilize limited graphic resources of the computer system. A progressive mesh (PM) based technique, a digital elevation model (DEM) and real-time optimally adaptive meshes (ROAM) are conventional techniques of representing a vast amount of terrain data in real time. These conventional techniques are applied to various fields of computer graphics, virtual reality and a geographical information system (GIS).

[0007] In U.S. patent application Ser. No. 6,611,267 issued to A. Migdal et al., entitled "System and Method for Computer Modeling of 3D Objects or Surfaces by Mesh Construction Having Optimal Quality Characteristics and Dynamic Resolution Capabilities," a three-dimensional modeling method and a system for objects or surfaces using the PM based technique are introduced. The PM based technique configures the mesh model dynamically by determining the order of inserting vertices of polygons within the mesh and gradually inserting the vertices, and thus, the mesh can be always maintained optimally. Also, managing the list including information on the insertion and the removal makes it possible to rapidly remove vertices from the mesh. However, the PM based technique needs to modify the mesh model dynamically to represent three-dimensional images. Hence, the PM based technique generally takes up a large portion of a memory and has a slow data representation rate.

[0008] The ROAM technique is discribed in an article by Duchaineau et al., entitled "ROAMing Terrain: Real-Time Optimally Adapting Meshes," IEEE Visualization on '97 Proceedings, pp. 81-88, 1997. The ROAM technique configures a binary tree of triangls to minimize the reconfiguration of a mesh processed in real time and is optimized by combining a gradual division of the triangle with a deferred list of priority rank calculation. However, the ROAM technique needs to dynamically reconfigure the mesh with various ranges of resolution to represent three-dimensional images. As a result, the ROAM technique may not be proper to a large-scale terrain system, which requires rapid terrain representation.

SUMMARY OF THE INVENTION

[0009] Accordingly, the present invention is directed to an apparatus and a method for representing a multi-level LOD three-dimensional image that substantially obviates one or more problems due to limitations and disadvantages of the related art.

[0010] An object of the present invention is to provide an apparatus for reconfiguring a large-scale terrain data in a computer system without taking up a large portion of a memory and a large amount of computation and representing the reconfigured large-scale terrain data, and a method therefor.

[0011] Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0012] According to an aspect of the present invention, there is provided an apparatus for representing a three-dimensional image with a multi-level LOD (level of detail), including: a patch configuration unit configuring a multi-level LOD hierarchical mesh for each hierarchical level with a different LOD level by arranging triangular patches of a higher level (level m+1, lower resolution) to have approximately k×k of triangular patches of an lower level (level m, higher resolution), where k is the number of horizontal and vertical grids at the lower level and sampling information on height of a target image on a regular basis to allocate the sampled height information to each vertex of the triangular patches included in the multi-level LOD hierarchical mesh; an LOD determination unit determining an LOD of each triangular patch according to a view point of a virtual camera; and a patch connection unit connecting the adjacent triangular patches with each other without gaps when the adjacent triangular patches among the triangular patches of the multi-level LOD hierarchical mesh have different LOD levels.

[0013] According to an another aspect of the present invention, there is provided a method for representing a three-dimensional image with a multi-level LOD (level of detail), including the steps of: configuring a multi-level LOD hierarchical mesh for each hierarchical level with a different LOD level by arranging triangular patches of a higher level (level m+1, lower resolution) to have approximately k×k of triangular patches of an lower level (level m, higher resolution), where k is the number of horizontal and